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The effect of living areas on the mortality rates of the patients with hip fracture

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Abstract
Aim: This study aims to evaluate the postfracture short- and long-term mortality rates in patients with a hip fracture living in urban and rural areas.
Material and Methods: This study included patients with a hip fracture who underwent surgical treatment between January 1, 2014 and May 31, 2017 in two different cities. The pre- and post-operative living areas of the patients were determined using the hospital network and the national death information system. The clinical data of 522 patients treated for hip fractures caused by low-energy trauma who live in either the urban areas (212 women, 134 men) or rural areas (103 women, 73 men) were evaluated in this study.
Results: The age and gender distribution of the patients in urban and rural areas were similar. There was no statistically significant difference between the groups, according to side, fracture type and comorbidity. Although 1-month mortality rates were lower in patients living in urban areas than in patients living in rural areas, there was no statistically significant difference between the groups ($p = 0.158$). Mortality rates of 1-year and 3-year follow-up were significantly lower in the rural population ($p<0.05$).
Discussion: We concluded that living area, advanced age and the presence of multiple comorbid disorders are independent risk factors associated with post-fracture long term mortality in patients with hip fractures.

Keywords
Hip Fracture, Mortality, Urban, Rural

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Introduction

Hip fractures, which are becoming more common due to the aging of the population, are one of the most important causes of mortality associated with orthopedics and traumatology in the elderly population. It has been estimated that the incidence of hip fracture patients will reach 2.6 million worldwide by 2025 [1-2]. Different factors such as age, gender, comorbidity, time to surgery, and treatment type have been detected to affect mortality rates in hip fracture patients. Individual factors (age, gender, and socio-demographic features) and the quality of the health care system are common reasons of morbidity and mortality [3]. There are important differences between urban and rural environments, such as social structure, education level, quality of the healthcare system, waiting times before surgery, and access to healthcare. Long waiting times before surgical treatment or the difficulty of accessing health care is an important risk factor that increases both complications and mortality rates in patients with hip fractures. Therefore, it is thought that urbanization affects mortality rates and complications after hip fracture [4, 5].

There have been studies examining the differences in hip fracture incidence between urban and rural living areas. However, the number of studies investigating the effect of differences in residence on mortality and complications following hip fracture is limited [6, 7].

In the present study, the effects of living in urban or rural areas on the mortality rates following a hip fracture were investigated. We hypothesized that the mortality rate is higher in the urban population and investigated the relationship between mortality rate and variables such as age, gender, duration before surgery, and comorbidity rate.

Material and Methods

This retrospective observational cohort study was conducted after the approval of our institution's ethics review board and performed in accordance with the Declaration of Helsinki (Approval number: 2020.05.2.01.045.r1.57).

Hip fracture patients who underwent surgical treatment between January 1, 2014 and May 31, 2017 in two different cities were included in this study. Clinical records of patients were accessed with the International Classification of Diseases (ICD) code S72.0-1. The pre- and post-operative living areas of the patients were determined using the hospital network and the national death information system.

International standard definitions were used to compare rural and urban living areas. The Organization for Economic Development and Cooperation (OECD), which has been working on rural areas since 1988, classifies living areas as rural or urban according to population density. This classification system is used by the European Union and Turkey [8]. According to the Turkish Statistical Institute (TSI), living areas with population of more than 20000 are defined as urban areas [9]. The living areas of the patients included in our study were determined as rural or urban according to the definition of (TSI).

The clinical data of 522 patients treated for hip fractures caused by low-energy trauma who live in either urban areas (212 women, 134 men) or rural areas (103 women, 73 men) were evaluated in this study. Patients with incomplete medical or death records, under 65 years of age, treated conservatively, having contralateral hip fractures, having pathological fractures, open fractures, isolated trochanteric and subtrochanteric fractures, periprosthetic hip fractures and high-energy trauma fractures were excluded from the study.

All clinical data examinations included age, gender, fracture and treatment type, comorbidity (0-2, 3+), American Society of Anesthesiologists (ASA) scores (1-4), anesthesia type (general or regional), time to surgery. Demographic, clinical and survival data of the patients are presented in Tables 1 and 2. Patients were divided into two groups according to the type of fracture as pertrochanteric and transcervical groups. Patients diagnosed with pertrochanteric fracture were treated with proximal femoral intramedullary nail osteosynthesis; patients with transcervical fracture were treated with hemiarthroplasty surgery. Patients were also evaluated in two groups as having 2 or fewer diseases and 3 or more diseases according to the presence of comorbid disease. ASA scoring was determined as 1: healthy, 2: presence of mild systemic disease, 3: presence of severe systemic disease, 4: presence of severe life-threatening systemic disease, 5: patients without life expectancy without surgical intervention. During the follow-up of patients, the survival was checked from the national death information system; one-month, one-year and three-year survivals were determined.

Statistical Analysis

Numeric variables were given as mean ± standard deviation, categorical variables were given as frequencies and percentage. Statistical analysis was performed using SPSS 21.0 (SPSS Inc., IBM, NY, USA). Comparison of means was performed using Student t-test; comparison of frequencies was performed using the Chi-Square test or Fisher's exact test. Then, significant variables with p-values <0.05 were inserted into a multivariate regression analysis to determine major predictors of 3-year mortality.

Results

Demographic and clinical data of the patients are presented in Table 1. The age and gender distribution of the patients in urban and rural areas were similar (p=0.544, p=0.150, respectively). There was no statistically significant difference between the groups, according to side, fracture type and comorbidity (p>0.05). Forty and thirty-nine percent of the patients who live in the urban and rural areas had 3 or more comorbidities, respectively.

The mean time to surgery was 2,95±1,27 days in the urban population, whereas it was 2,82±1,38 days in the other group (p=0.276). The average duration of surgery was 94,32±29,94 minutes for patients who live in urban area and 99,66±34,48 minutes for those who live in rural area (p=0.068). Although 1-month mortality rates were lower in patients living in urban areas than in patients living in rural areas, there was no statistically significant difference between the groups (p = 0.158). Mortality rates of 1-year and 3-year follow-up were significantly lower in the rural population (p<0.05) (Table 2). In logistic regression, living in urban areas was shown to increase the 3-year mortality risk as 1.8 times of the risks in rural life (p=0.04, OR 1.2-3.4, CI=95%). Three or more comorbidities and

old age have been found as risk factors for 3-year mortality (p<0.01, p<0.01, respectively) (Table 3).

Table 1. Descriptive data of hip fracture patients by urbanization category

Variable	Urban Area (n: 346)	Rural Area (n: 176)	P-Value
Gender			
Female	212	103	0.544
Male	134	73	
Mean age	79,62± 7,64	80,66± 8,07	0.150
Side			
Right	168	87	0.850
Left	178	89	
Fracture type			
Extracapsular	163	82	0.911
Intracapsular	183	94	
Comorbidity			
< 3	206	107	0.782
≥ 3	140	69	
ASA			
1	11	5	0.671
2	112	50	
3	211	112	
4	12	9	
Anesthesia type			
General	31	21	0.284
Regional	315	155	
Duration of anesthesia (min)	94,32±29,94	99,66±34,48	0.068
Mean time until surgery (day)	2,95±1,27	2,82±1,38	0.276

*p<0.05

Table 2. Survival data of hip fracture patients by urbanization category

Variable	Urban Area (n: 346)	Rural Area (n: 176)	P-Value
1-Month mortality			0.158
Survivor	326	160	
Non-survivor	20	16	
1-Year mortality			0.037*
Survivor	216	126	
Non-survivor	130	50	
3-Year mortality			0.021*
Survivor	142	91	
Non-survivor	204	85	

*p<0.05

Table 3. Major predictors of 3-year mortality in hip fractures according to binary logistic regression analysis

Variable	Multivariate Analysis (Logistic Regression)	
	Odds Ratio (95% Confidence Interval)	P-value
Urban area	1.78 (1.2-2.6)	<0.01
Age	1.06 (1.04-1.09)	<0.01
Comorbidities ≥3	1.97 (1.3-2.8)	<0.01

Discussion

Hip fractures are among the common fractures in the elderly population and generally require hospitalization and surgical treatment [2]. In worldwide, there have been few studies examining the differences in post-hip fracture mortality rates between urban and rural living areas [6, 7]. Our study is the first study on this subject in Turkey. In hip fracture patients, we examined individual data (such as age, gender, side, fracture type, comorbidity, ASA scoring, anesthesia type, duration of anesthesia, mean time until surgery) and survival states (1-month, 1-year and 3-year). According to our results, the risk of mortality after a hip fracture is higher in the long-term period among the urban population than among the rural population. These results were actually consistent with our hypothesis.

In the literature, it has been reported that there is an increase in the functional disabilities, complications and mortality incidences in the elderly population following a hip fracture [10]. Patients with hip fractures have been shown to have a 3-fold higher mortality rate than the normal population [11]. In several studies, the mortality rate following a hip fracture has been reported between 14-36% in a one-year follow-up [12, 13]. The main causes of high mortality rates are age, concomitant cardiac, pulmonary and renal diseases, smoking, and long waiting periods before surgery [10, 14]. Along with these factors, studies conducted in different countries/regions have shown that the urban-rural lifespan of patients affects the short and long-term mortality rates [6, 7, 15]. In the present study, we investigated the effect of living in urban and rural areas on mortality from hip fractures in the Turkish population. In addition to being the first study on this issue in Turkey, our study reported the highest number of hip fracture patients among long-term studies investigating the mortality rate in the Turkish population. The short-term mortality rate of patients was lower in urban life, while their mortality rates in the first and third years of follow-up were higher than the patients living in rural areas.

There are differences between urban and rural living populations in terms of environment, lifestyle, education level and access to the health services (The results of address-based population registration system, 2019. (2020, February). Turkish Statistical Institute Press Release. 33705) [16]. The risk of hip fracture in urban and rural populations has been investigated in many studies [17,18]. A detailed study by Tuzun et al. [19] examining the hip fracture incidence and the prevalence of osteoporosis in Turkey reported that the incidence of hip fractures was higher among urban population and among females. However, there are limited studies in the literature investigating the risk of mortality [3, 15, 20]. In our study, patients were evaluated in terms of age, gender, fracture side and type, duration until surgery, ASA scores, and anesthesia type. There was no significant difference in data of both groups, suggesting reliable, valuable and objective results of the study.

It has been shown that the rural population generally loses more time before the treatment of hip fractures than those living in the city [15]. Moreover, it has been reported in various studies that there is a disadvantage in reaching a physician lately in the rural population [16, 21]. The limited number of physicians in

surgical branches in rural areas leads to concerns about delayed treatment planning and its adverse effects on the treatment outcomes [22]. In a study by Abrams et al, it was reported that access to high-quality cardiac care was more limited in the rural population, and lower revascularization and higher mortality rates were detected in this patient group [23]. In our study, we found that the 1-month mortality rate of the patients with hip fractures was higher among the rural population, but not statistically different from the urban population. Although we consider that this finding may be related to differences in delayed initial treatment and quality of early post-discharge care among urban and rural areas, more valuable results will be obtained from further nationwide cohort studies.

In the present study, in opposition to the results of early mortality rate, one-year and three-year long-term mortality rates were found to be significantly higher in the urban population compared to the rural population. The reasons of mortality following a hip fracture differ in early and late periods [11, 14]. Juhász et al. found a higher risk of developing contralateral hip fractures in the urban population than in the rural population, suggesting that this may be related to osteoporosis [20]. The lower long-term mortality rates in the rural population can be explained by the possible high level of physical activity. It has been shown that increased physical activity associated with daily and traditional lifestyles in rural life is associated with a lower mortality rate [6]. A better physical condition was also reported to be important in the rehabilitation process, which is very crucial in the treatment outcomes of a hip fracture [24]. On the other hand, in a two-year follow-up study by Mortimore et al., it was reported that a low social interaction was associated with high mortality rate following a hip fracture [25]. We suggest that increased physical activity and high social interaction in the rural population has a positive effect on long-term mortality rates of hip fracture.

The hip fracture patients who live in the city with the highest urban population and the city with a high rural population were included in this study (Turkish Statistical Institute Press Release. (2020, February). 33705). The results of our study indicate a public opinion for the urban-rural comparison in Turkey. Nevertheless, the main limitation of our study is that it is not a nationwide comparison of urban and rural populations, but a regional comparison of those living in two specific cities. Another possible limitation in our study is that patients were expected to live in the city where they were treated and evaluated accordingly. Finally, the mechanism of injury, BMI and bone mineral density that are effective in mortality among patients after a hip fracture were not taken into consideration due to the inadequate clinical records.

Conclusions

Although there was no statistically significant difference in mortality rates in the first month in patients living in urban and rural regions, mortality rates in 1 and 3 years were significantly higher in patients living in the urban area.

In conclusion, living in an urban area, presence of more than two comorbidities and old age increase the risk of mortality in patients with hip fractures in the long term.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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Conflict of interest

None of the authors received any type of financial support that could be considered potential conflict of interest regarding the manuscript or its submission.

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